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Instructional Influence on Human Performance: The Effects of Trainee's Verbal Behavior

Eliot H. Shimoff and Byron A. Matthews
University of Maryland Baltimore County

Basic Research

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Skilled performance may be defined in terms of sensitivity to contingent relations between behavior and its consequences, and the adaptability of behavior to changes in those contingencies. In an experimental analysis of the effects of verbal behavior on the development of skilled nonverbal performance, students' presses on left and right buttons occasionally made available points exchangeable for money. Blue lights over the buttons were correlated with multiple random-ratio (RR) random-interval (RI) components; usually, the RR schedule was assigned to the left button and the RI to the right. (Continued)

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During interruptions on the multiple schedule, students filled out sentence-completion guess sheets (e.g., The way to earn points with the left button is to...). For different groups, guesses were shaped with differential points also worth money (e.g., successive approximations to "press fast" for the left button), or were instructed (e.g., Write "press slowly" for the left button), or were simply collected. Control of rate of pressing by guesses was examined in individual cases by reversing shaped guesses, instructions, and/or multiple-schedule contingencies. Shaped guesses produced guess-consistent pressing even when guessed rates opposed those characteristic of the contingencies (e.g., slow RR and fast RI rates), whereas guesses and rates of pressing rarely corresponded after unsuccessful shaping of guesses or with guessing neither shaped nor instructed; instructed guesses and pressing were variably related. In other words, when contingency-governed (shaped), verbal behavior controlled nonverbal responding. When rule-governed (instructed), its control of nonverbal behavior was inconsistent; in some instances, the nonverbal behavior led rather than followed the verbal.

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Instructional Influence on Human Performance: The Effects of Trainee's Verbal Behavior

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INSTRUCTIONAL INFLUENCE ON HUMAN PERFORMANCE: THE EFFECTS OF TRAINEE'S VERBAL BEHAVIOR

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INSTRUCTIONAL INFLUENCE ON HUMAN PERFORMANCE: THE EFFECTS OF TRAINEE'S VERBAL BEHAVIOR

INTRODUCTION

One feature common to most training programs, even those aimed at the development of motor skills, is a verbal description (in either lecture or textbook format) of acceptable performance. Furthermore, most training programs include steps to ensure and explicitly test the extent to which such verbal descriptions of performance have entered into the verbal repertoire of the trainee. The assumption underlying the verbal component of such training procedures is that the availability in the trainee's repertoire of an accurate description of the desired performance is necessary for the establishment of the performance. There are, however, relatively few experimental studies which have directly addressed this issue. In fact, if skilled performance is defined in terms of sensitivity to the consequences of one's own behavior and adaptability to changes of these consequences, previous research (e.g., Matthews, Shimoff, Catania, & Sagvolden, 1977; Shimoff, Catania, & Matthews, 1981) has found that instructions sometimes inhibit the development of skilled (contingency-sensitive) performance. By extension, it seems likely that some forms of self-directed verbal behavior -- what a trainee says to himself -- may also induce insensitivity.

Shimoff and Matthews (1981) have outlined the rationale for the experimental analysis of skilled performance, and found that contingency-shaped, but not instructed responding was sensitive to subtle changes in contingencies. The present experiment directly follows from those findings, and examines the role of a trainee's verbal behavior in the development of skilled motor performance.

Verbal behavior enters into research on nonverbal human operant behavior in at least two ways. First, an experimenter may establish nonverbal responding through instructions rather than through contingencies. Instructed or rule-governed responding has different properties than shaped or contingency-governed responding (Skinner, 1966, 1969, pp. 157-171); the former is less likely than the latter to change with its consequences or, in other words, is less sensitive to contingencies (Matthews et al., 1977; Shimoff et al., 1981). Second, an experimenter may obtain verbal reports in post-session interviews. The relations between such reports and nonverbal responding are typically unspecified. The verbal behavior may depend on prior nonverbal responding, it may be similar to earlier and perhaps private verbal behavior upon which nonverbal responding depended, or it may be related to prior nonverbal responding in other undetermined ways (Harzem, Lowe, & Bagshaw, 1978; Lowe, 1980).

One way to study the relation between verbal and nonverbal responding is to manipulate one and observe whether changes occur in the other (e.g., Birch, 1966; Lovaas, 1961, 1964a, 1964b; Meichenbaum & Goodman, 1969; Sherman, 1964); another is to establish correspondences between verbal and nonverbal behavior and observe whether they transfer to new settings or new response classes (e.g., Israel & Brown, 1977; Israel & O'Leary, 1973; Risley, 1977; Risley & Hart, 1968; Rogers-Warren & Baer, 1976). In either case, the distinction between rule-governed and contingency-governed behavior may be relevant. Verbal behavior or nonverbal behavior or their correspondences may be either shaped or instructed, and conclusions drawn from one case may not be applicable to the other.

The present research examined the effects on nonverbal responding of either shaping or instructing students' verbal reports. The nonverbal responding was button-pressing, and the verbal report was a written sentence completion. Presses on one button produced points according to a random-ratio (RR) schedule whereas those on a second button did so according to a random-interval (RI) schedule. (Points earned vary directly with the rate of RR pressing whereas they remain roughly constant over a range of RI rates, and higher rates are typically maintained by RR than by RI schedules: Catania, Matthews, Silverman, & Yohalem, 1977; Matthews et al., 1977.) After exposures to each schedule, students completed left-button and right-button sentences (guesses). In some cases, points earned by guessing depended on guess content, and either shaping or instruction was used to establish response-rate guesses (e.g., "press fast" for the RR button and "press slow" for the RI button). In others, guesses had no differential consequences; they earned points regardless of their content. Variations in procedure were then concerned with whether nonverbal behavior followed verbal behavior or vice versa.

Method

Subjects

About fifty UMBC undergraduates participated in sessions at two- to four-day intervals, as an option in satisfying Introductory Psychology course requirements. Data are not presented from those who attended only a single session, whose performance was affected by equipment failures, or who were used in exploratory procedures.

Apparatus

In a sound-attenuating cubicle, each student was seated facing a console and a set of "guess sheets." The upper portion of the console contained a point-counter, two green lamps and a small black button. Whenever the two green lamps were lit, a press on the black button turned them off and added a point to the counter. The lower portion contained two 2.4-cm diameter red buttons, each beneath a blue lamp and operable by a minimum force of 15 N. White noise presented through headphones masked sounds from electromagnetic recording and control equipment in an adjacent room. When the blue lamp above either red button was lit, presses on that button briefly interrupted the masking noise.

Procedure

Button-presses. Presses on the red buttons occasionally initiated the nominal reinforcement cycle (the lighting of the green lamps, during which a press on the black button produced a point). Presses on one red button did so according to a random-ratio schedule in which each response was eligible for reinforcement with a probability of .05 (RR 20). Presses on the other did so according to a random-interval schedule that made eligible for reinforcement the first response after a variable interval determined by selecting pulses

generated at the rate of 1 per sec with a probability of .10 (RI 10-sec with t=1.0 and p=.10). In most conditions, the RR schedule was arranged for left-button presses and the RI schedule for right-button presses; during some conditions, the assignment of schedules to buttons was reversed.

The left-button and right-button lamps lit alternately (multiple RR RI) for 1.5 min each excluding reinforcement cycles, and sessions always began with the left-button schedule. The two lamps were never lit simultaneously, and presses on the button beneath an unlit lamp had no scheduled consequences. After 1.5 min of each schedule (3-min schedule cycle), both blue lamps were turned off and a buzz replaced the white noise in the headphones; this marked the beginning of the guess period.

Guesses. An ample supply of guess sheets was available next to the console. Each guess sheet had six sentences to be completed. The first three were "The way to turn on the green lights with the left button is to:"; the last three differed only in specifying the right button. Students were instructed to pass each completed sheet through an 8.0-cm diameter hole in the wall next to the console. To shape guesses, an experimenter assigned each guess 0, 1, 2 or 3 points, writing point-values next to each guess and passing the sheet to the student through the hole in the wall; the guess period ended when the student returned the graded guess sheet. At the end of the guess period, the buzz was replaced by white noise and the light above the left button was again lit. Points earned by guessing did not appear on the point-counter but at the end of each session students were given a card showing total session earnings; they were paid at the end of their final sessions. Sessions lasted about 50 min and, depending on time spent writing guesses, included 8 to 12 schedule cycles and guess periods.

Shaping. For sessions involving the shaping of guesses, the following instructions were mounted on the wall above the console. Eighteen students participated in this procedure.

> Each point you earn is worth 1 cent. For example, if you earn 300 points, you will be paid $3.00.
>
> You have two ways to earn points: (1) By pressing the RED BUTTONS, and (2) by GUESSING.
>
> RED BUTTONS. At the lower center of the console are two red push buttons. At any time, only one of the two red buttons will work (the blue lights above the buttons will tell you which one is working).
>
> If you press in the right way: (1) The GREEN LIGHTS next to the counter will light up, and (2) when the green lights come on, you can add 1 point to your total by pressing the small BLACK BUTTON next to the counter.
>
> [GUESSING. Every few minutes, the console will shut off for about 2 minutes. During this time, you may fill in as many blanks as you wish on the GUESS SHEET.

When you have written as many guesses as you wish (don't take longer than about 2 minutes altogether), roll up the guess sheet and SLIDE IT THROUGH THE HOLE IN THE WALL just to the left of the console.

The sheet will come back with your point earnings written in red. Each guess can earn 0, 1, 2, or 3 points.

After you have seen your points for guessing, PASS THE SHEET BACK AGAIN, and the console will come on.]

Do not remove your headphones once the experiment is under way.

Shaping was accomplished by differentially awarding points to guesses. Although the details of shaping varied across students, the following characteristics became established as the experimenters' differential reinforcement of verbal behavior was shaped. Guesses that included no statement about response rate generally were given 0 points (although after an extended series of guesses specifying topography, a guess that omitted topography might earn 1 point). Guesses specifying both appropriate rate and topography generally earned 2 points; only guesses that specified appropriate rate alone ordinarily earned the full 3 points.

Nondifferential points for guessing. The sampling of verbal behavior, regardless of differential consequences, might affect button-pressing, and nondifferentially reinforced guesses might come under the control of button-pressing. These effects were assessed with eight students for whom each completed guess sheet was worth 10 points, regardless of content. The guess period ended when the guess sheet was passed through to the experimenter. For these students, the following sentences replaced the bracketed sections of the instructions:

GUESSING. Every few minutes, the console will shut off for about 2 minutes. Duwing this time, you may fill in as many blanks as you wish on the GUESS SHEET. Each guess sheet you turn in is worth 10 points in extra earnings (you may turn in only one sheet per off period).

When you have written as many guesses as you wish (don't take longer than about 2 minutes altogether), roll up the guess sheet and SLIDE IT THROUGH THE HOLE IN THE WALL just to the left of the console. The console will then come back on.

Instructed guesses. The effects of shaped guesses may differ from those of guesses established by instructions. To assess this difference, differential points for guesses were arranged for ten students who were given the original instructions and then a sheet with the following message. In all instances of instructed guessing, guesses consistent with instructions always earned 3 points each.

To earn maximum points for guessing: Write "press fast" [or "slowly"] for the left button and write "Press slowly" [or "fast"] for the right button.

Instructed button presses. In a few sessions, button-pressing was directly instructed. In these cases, differential points for guesses were discontinued and the student was given a sheet with the following message:

To maximize earnings with the buttons, you should press the left [or right] *button fast and press the* right [or left] button slowly.

Discontinuing differential consequences for guesses. In conditions with only presses instructed and in those with neither presses nor guesses instructed, guess sheets were collected but not returned. In these cases, students were given the following written message:

You will now get 10 points for each guess sheet you fill in, no matter what you guess.

Results

Table 1 summarizes the overall findings. The initial effects of each treatment were different, and varied sequences of procedures were therefore arranged for each group and, in many cases, for different students within a group. In exploratory sessions with button presses either shaped or instructed, the present multiple RR RI schedules did not produce consistent RR and RI rate differences, as occurs with shaped responding when these schedules are presented singly in successive sessions (Matthews et al., 1977). Typically, RR and RI rate differences occurred only after rate guesses had been generated by differential reinforcement or by instructions.

Shaping produced differential guesses in 8 of 18 cases. In each of the successful cases of shaping, differential guesses were accompanied by corresponding differential pressing rates. Reversals of rate guesses could then be used to determine whether the verbal behavior controlled pressing rates or vice versa. Reversals of rate guesses were accomplished in all but one of the eight cases, and each was accompanied by a corresponding reversal of pressing rates. In the exception, pressing rates remained consistent with the unreversed guessing. For some of the remaining ten cases shaping produced nondifferential rate guesses ("fast" for both buttons or "slow" for both buttons), and for others shaping of rate guesses was unsuccessful. In both instances, reversals of rate guesses could not be studied.

The eight cases of nondifferential points for guessing, like those of unsuccessful shaping, typically involved small and/or unsystematic differences in pressing rates and therefore also precluded reversals. In one exception, differential pressing rates were accompanied by differential rate guesses, and both pressing rates and guesses reversed after a reversal of RR and RI contingencies.

Table 1

Summary of the Findings

Condition	Cases	Outcome
Shaping of guesses	18	Differential rate guesses and their reversals were established in about half the cases, in each of which guesses were followed by corresponding differential button-press rates even in opposition to button-press contingencies; when differential guesses were not established, systematic differential button-press rates did not occur.
No contingencies arranged for guesses	8	In most cases, differential rate guesses did not occur and button-press rate differences were small and/or unsystematic; in the single exception, differential button-press rates, accompanied by corresponding rate guesses, reversed with reversal of button-press contingencies.
Instructing guesses	10	Differential rate guesses and their reversals were consistently established by instructions, but were accompanied by varied patterns of button-press rates corresponding to guesses in some cases and inconsistent with guesses in others; in about half the cases, reversals of button-press contingencies produced reversals of button-press rates, sometimes accompanied by corresponding reversals of guesses.

The varied effects of instructed guesses on pressing rates made the ten cases in this condition individual problems of experimental analysis. Reversals of instructed guesses, reversals of RR and RI contingencies, and instructions of pressing rates were used to determine whether guesses and pressing rates were independent and, if not, whether guesses controlled pressing rates or vice versa. In some cases verbal and nonverbal responses varied independently; in others they varied together, with different directions of dependency. In some cases, button pressing was sensitive to RR and RI contingencies; in others it was not.

Shaped guesses

Figure 1 shows data from five students for whom guesses were shaped consistent with the respective button-pressing contingencies, i.e., "fast" guesses for the left (RR) button and "slow" guesses for the right (RI) button. For each student, the upper frame shows button-pressing rates in successive pairs of schedule components, and the lower shows mean points per left-button and right-button guess.

For Student 6 (upper left), pressing rates on the two buttons were approximately equal in the first session. As shaping progressed, "fast" guesses for the left button and "slow" guesses for the right button, and therefore points per guess, increased. Guesses initially consisted of five or six words, such as "quick, quick, slow, quick, slow;" shaping involved giving points for larger proportions of "quick" for left-button guesses and of "slow" for right button guesses. Pressing rates diverged as guesses became more consistent. Reversal of the contingencies for guesses, with points now awarded for "slow" left guesses and "fast" right guesses, gradually produced reversal of the guesses. Pressing rates also reversed, remaining consistent with the guesses: "slow" left guesses were accompanied by decreasing left-button RR rates and "fast" right guesses by increasing right-button RI rates.

For Student 8, button-pressing rates became differentiated after rate guesses emerged but about two cycles before they became the dominant form of guessing. Rate guesses took the form of "press it fast" and "press it slow" for the left and right buttons respectively; nonrate guesses included force and rhythmic patterns. When guess contingencies were reversed, both guesses and pressing rates reversed rapidly; left "press it slow" guesses were now accompanied by relatively low-rate left-button pressing and right "press it fast" guesses by relatively high-rate right-button pressing. In the one postreversal component pair in which right-button RI rate was not higher than left-button RR rate, guesses were "slow" for both left and right buttons in the following guess period.

Initial guesses by Student 9 were "slow" for both buttons, and both rates decreased. As soon as "fast" left-button guesses appeared, pressing rates diverged. Left-button guesses were of the form "push fast until the green light comes on" whereas right-button guesses were typically "wait, push once." When guess contingencies were reversed, "wait" left-button guesses and "press fast" right-button guesses emerged rapidly; pressing rates followed the

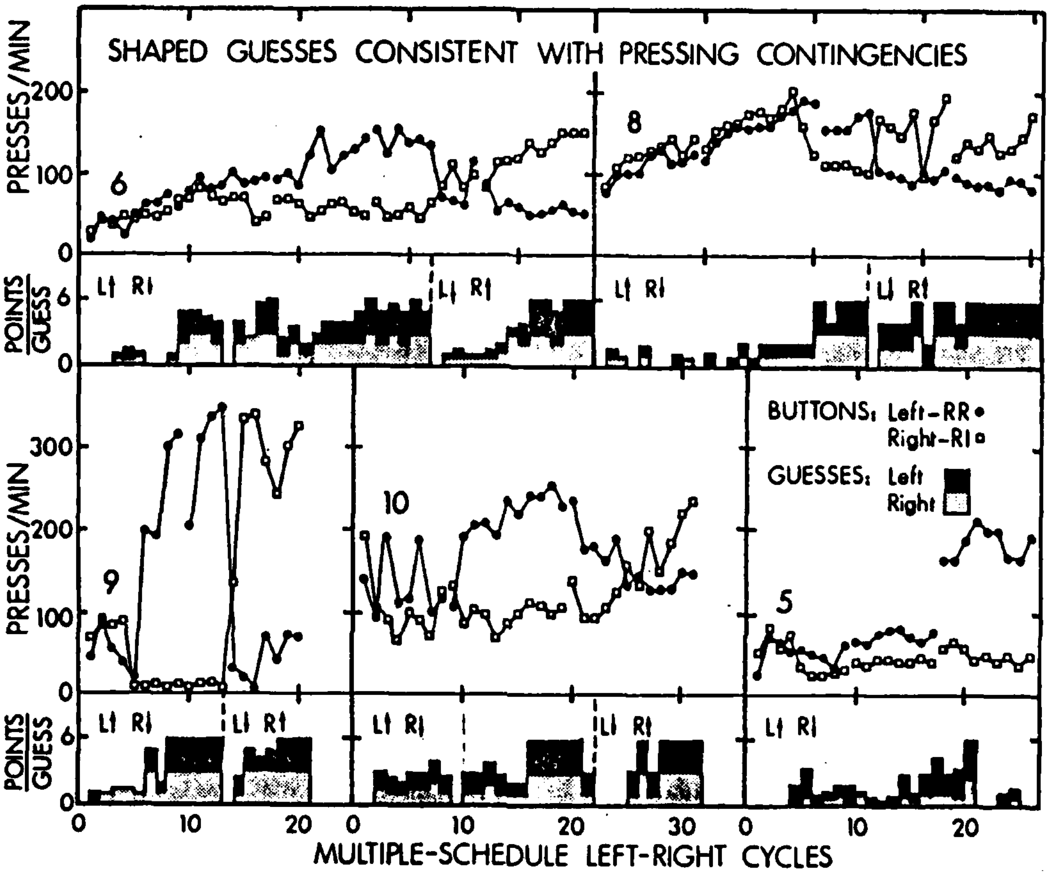

Figure 1. Responding of five students, identified by number, for whom guesses initially were shaped consistent with pressing contingencies ("fast" for left-button RR schedule and "slow" for right-button RI schedule). Data for each student include rates of pressing in successive multiple-schedule components in the top frame and mean points awarded per guess (3-point maximum for each button) in the bottom frame. In top frames, interruptions between sessions are indicated by unconnected points. In bottom frames, arrows labelled L and R indicate whether guess-points depended on "fast" (upward arrow) or "slow" (downward arrow) guesses. The dashed vertical lines in lower frames indicate reversals of the consequences for guessing; no reversal was arranged for Student 5. RR - random ratio; RI - random-interval; L - left; R - right.

guesses, although left RR rates remained somewhat higher than earlier right RI rates also correlated with "wait" guesses. Postreversal left RR rates produced less than one-fifth the points per component than they had before the guess reversal.

For Student 10, RR button-pressing rates higher than RI rates were evident within the first session, even though guesses were variable; they included "push down fast," and "push down slowly," as well as descriptions of button-pressing topography and sequence. Larger rate differences developed in the second session, and about six cycles later all nonrate guesses dropped out. When guess contingencies were reversed, guessing also reversed; correspondingly, right-button rates increased and left-button rates decreased. As with Student 9, left RR rates remained higher than earlier right RI rates also correlated with "slow" guesses.

For Student 5, guesses were typically long phrases that included rate and such other dimensions as number of responses and temporal patterning. By the third cycle of the third session, the nonrate statements dropped out. Substantial differences in pressing rates that developed in the third session continued even though later guesses shifted to number of presses and no longer earned points.

Figure 2 shows data from five students for whom guesses were initially shaped in opposition to the button-pressing contingencies (i.e., "slow" guesses for the left RR button and "fast" for the right RI button). For Student 18, button-pressing rates gradually diverged as guesses were shaped; guesses were of the form "push the button at an irregular speed (slow)" and "push the button at an unsteady quick speed." After reversed guess contingencies produced "fast" left RR and "slow" right RI guesses, RI rates decreased below earlier RR rates, and RR rates increased substantially above earlier RI rates. In other words, "fast" guesses were consistently correlated with higher pressing rates than "slow" guesses, but within each class of guesses RR contingencies still maintained higher rates than RI contingencies.

For Student 25, early guesses included "press fast" and "press slowly"; as such other guesses as "push soft," "push hard" and "push in multiples of 3" decreased, differences in button-pressing rates increased. When guess contingencies were reversed, guesses and pressing rates reversed correspondingly.

For Student 14 [illegible] ifference in pressing rates developed about five guess periods after "sl[illegible] [illegible] "fast" respectively had become the virtually exclusive left and righ[illegible] guesses. This rate difference gradually diminished, and left RR rates [illegible]times exceeded right RI rates even though such rates were inconsistent with guesses. When the guess contingencies were reversed, guesses reversed after a single guess period without points, and right RI rates ("slow" guesses) decreased below left RR rates ("fast" guesses).

For Student 12, right RI rates were initially slightly higher than left RR rates. Guesses included topography (e.g., "push the center of the button")

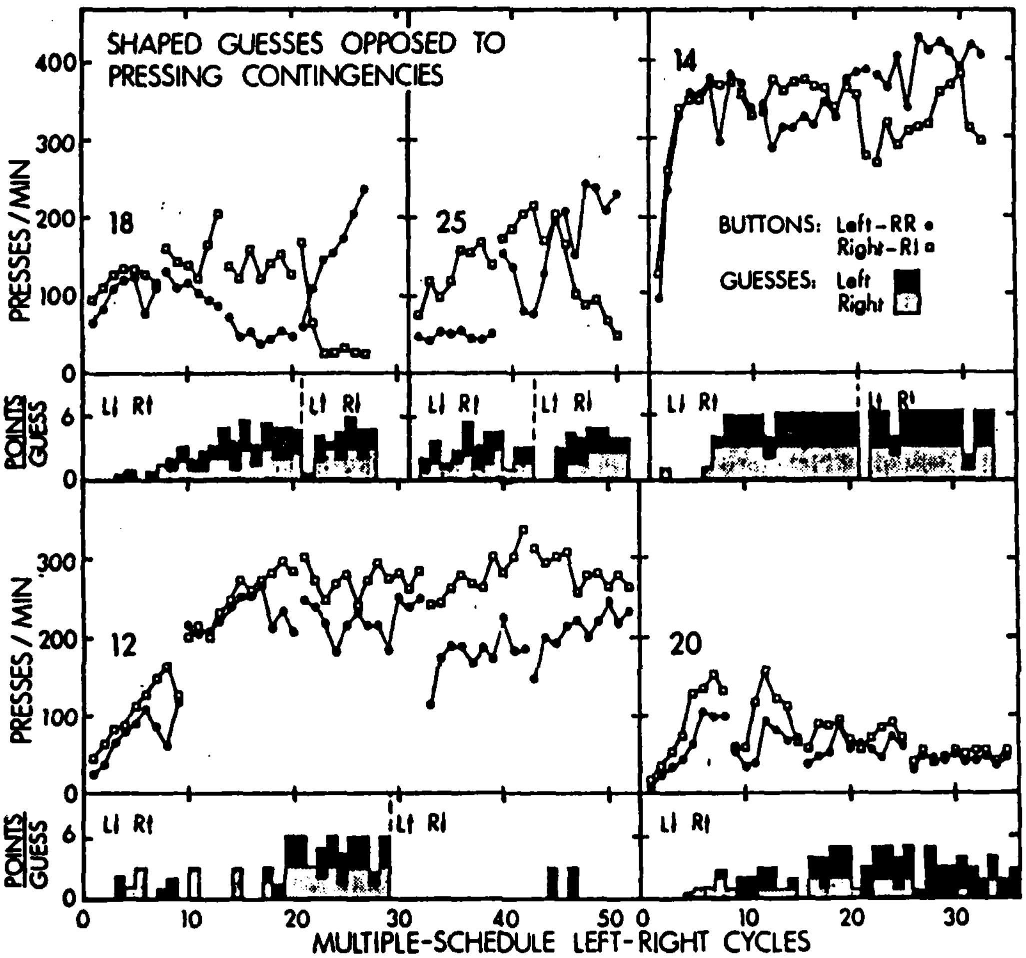

Figure 2. Responding of five students for whom guesses initially were shaped in opposition to pressing contingencies ("slow" for left-button RR schedule and "fast" for right-button RI schedule). For Student 20, "slow" guesses shaped for the right button occurred for both buttons, and no reversal of the consequences for guessing was arranged. Details as in Figure 1.

and temporal patterning (e.g., "press fast but evenly spaced") as well as rate alone (e.g., "press as fast as you can" or "push, pause, push"). As shaping of guesses progressed, left RR rates ("slow" guesses) decreased and pressing rates consistent with guesses developed. When the guess contingencies were reversed, however, guesses did not change even though they no longer earned points, and RI rates ("fast" guesses) remained higher than RR rates ("slow" guesses).

For Student 20, shaping produced transient periods of "slow" left and "fast" right guesses, typically combined with other material (e.g., "keep pressing hard many times"). Pressing rates were consistent with rate guesses. Eventually, however, "fast" right guesses ceased and "slow" guesses dominated for both left and right buttons, and rates on both buttons decreased.

In general, shaped guesses controlled pressing rates; regardless of the button-pressing contingencies, rates conformed to guesses. This sometimes occurred even though accompanied by substantial decreases in point-earnings (e.g., Figure 1, Students 6 and 9). The effects of contingencies were often evident in higher RR than RI rates accompanying equivalent guesses (e.g., "slow" RR left rate before reversal versus "slow" RI right rate after reversal for Student 18, Figure 2), but were typically much smaller than the rate differences engendered by differential rate guesses.

Unsuccessful shaping

Data from eight students for whom shaping of guesses was unsuccessful are shown in Figure 3. In general, button-pressing rates did not become systematically differentiated. For Students 11 and 16, guesses generally included topography: e.g., "press the side (top, bottom) of the button," "twist the button." For Student 19, both right-button and left-button guesses included "quickly" at about equal frequencies, typically embedded in complex sequences (e.g., "press twice quickly, wait, then press three times quickly"). Guess points seemed mainly to affect the numbers and orderings within these sequences. The guesses of Student 24 included both "fast" and "slow" for each button, but neither guess increased in frequency. This student never repeated the same guess for a given button on a single guess sheet. Guesses for Student 13 typically included statements like "press many times" for the left button. In shaping, this was treated as equivalent to "press fast." Right-button guesses were either identical to left-button guesses or were omitted, and both pressing rates increased. For Student 15, guesses stated numbers of presses but not rates (e.g., "push 8X," "push 20X"). Shaping of small left and large right numbers did not produce differential rates of pressing. For Student 22, guesses of the form "increase (decrease) number of pressings" were treated as rate guesses even though they did not include rate terms such as "fast" or "slow." A pressing rate difference in the opposite direction lasted for about a session, after which these guesses were uncorrelated with rates of pressing. Consistent button-pressing rate differences also did not occur for Student 23, whose highly variable guesses included "wait" and "don't wait" along with such forms as "talk," "do something," "listen," and "go to sleep."

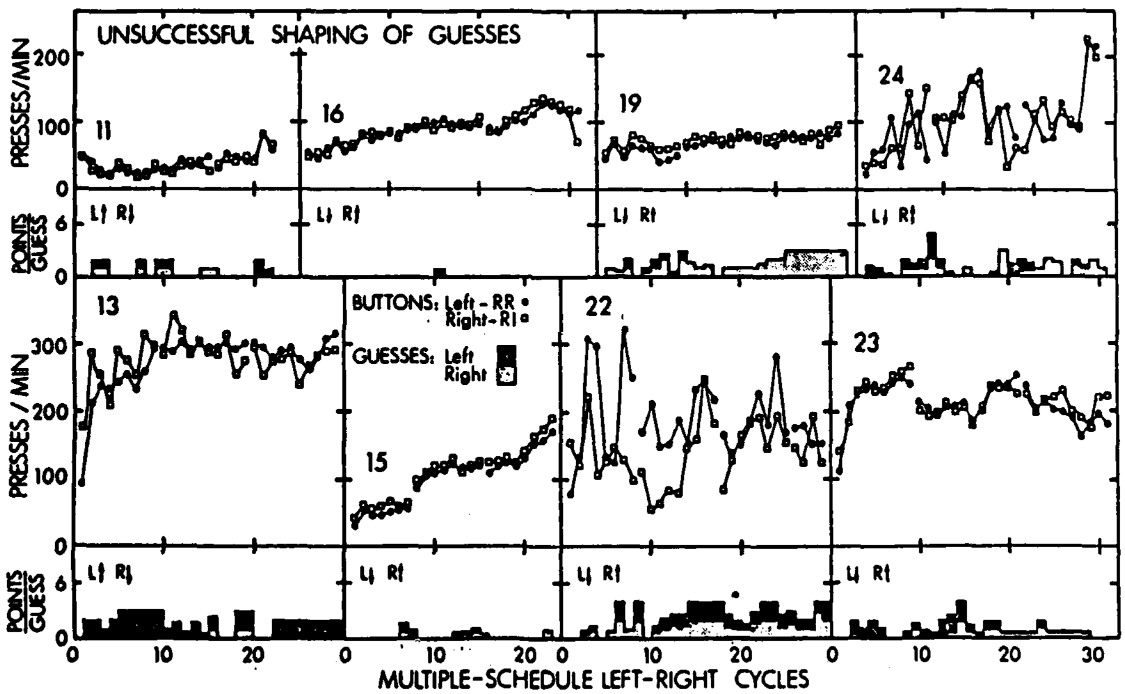

Figure 3. Responding of eight students for whom the shaping of guesses was unsuccessful. Details as in Figure 1.

In general, differences in pressing rates did not emerge when shaping failed. The absence of systematic rate differences is important because it demonstrates that differential button-pressing contingencies alone are insufficient to produce rate differences in this procedure. Furthermore, although six of the eight shaping failures involved shaping of guesses opposed to the pressing contingencies, it is unlikely that the opposition of attempted shaping to the button-pressing contingencies was crucial; differentiated left and right rates had not developed when shaping began, and it is not clear how contingencies arranged for pressing could disrupt guesses, which produced points independently of pressing, without affecting the pressing rates themselves.

Nondifferential points for guessing

Figure 4 presents data from the eight students for whom no differential consequences were arranged for guesses; each completed guess sheet earned 10 points without regard to the content of the guesses. Among the guesses of Students 26, 29 and 32, rate guesses were absent or rare. Of these, the only consistent rate difference occurred for Student 26, for whom left RR rates became consistently lower than right RI rates. For Student 28, occasional "fast" and "slow" guesses were accompanied by increases in both left and right pressing rates, with left rates consistently somewhat higher in later cycles. Guesses for Student 34 included "fast" for both buttons, and both pressing rates increased together. For Student 30, as for 28, occasional rate guesses (mostly "press rapidly," which was more often a left than a right guess) were accompanied by relatively high pressing rates and then by left RR rates predominantly higher than right RI rates. For Student 31, left-button rates increased at about the same time as "fast" left-button guesses; occasional "slow" right-button guesses were accompanied by descriptions of topography.

For Student 27, guesses combined rates with topographies (e.g., "turn slowly as you push slowly down," and "press quickly and lightly"); corresponding differences in pressing rates appeared within the first session. When the pressing contingency was reversed in the second cycle of the third session, so that left and right presses now respectively earned points according to RI and RR schedules, left rates decreased as right rates increased and guesses followed pressing rates. Thus, pressing rates were sensitive to the differential ratio and interval contingencies and controlled rather than were controlled by the guesses.

In summary, when guesses did not produce differential consequences, rate guesses sometimes occurred but did not differ systematically for the two buttons. Although RR rates were higher than RI rates in some cases, this difference was consistent and substantial only for Student 27. Guessing without differential consequences therefore does not ordinarily engender differential rates of pressing under the control of differential guesses.

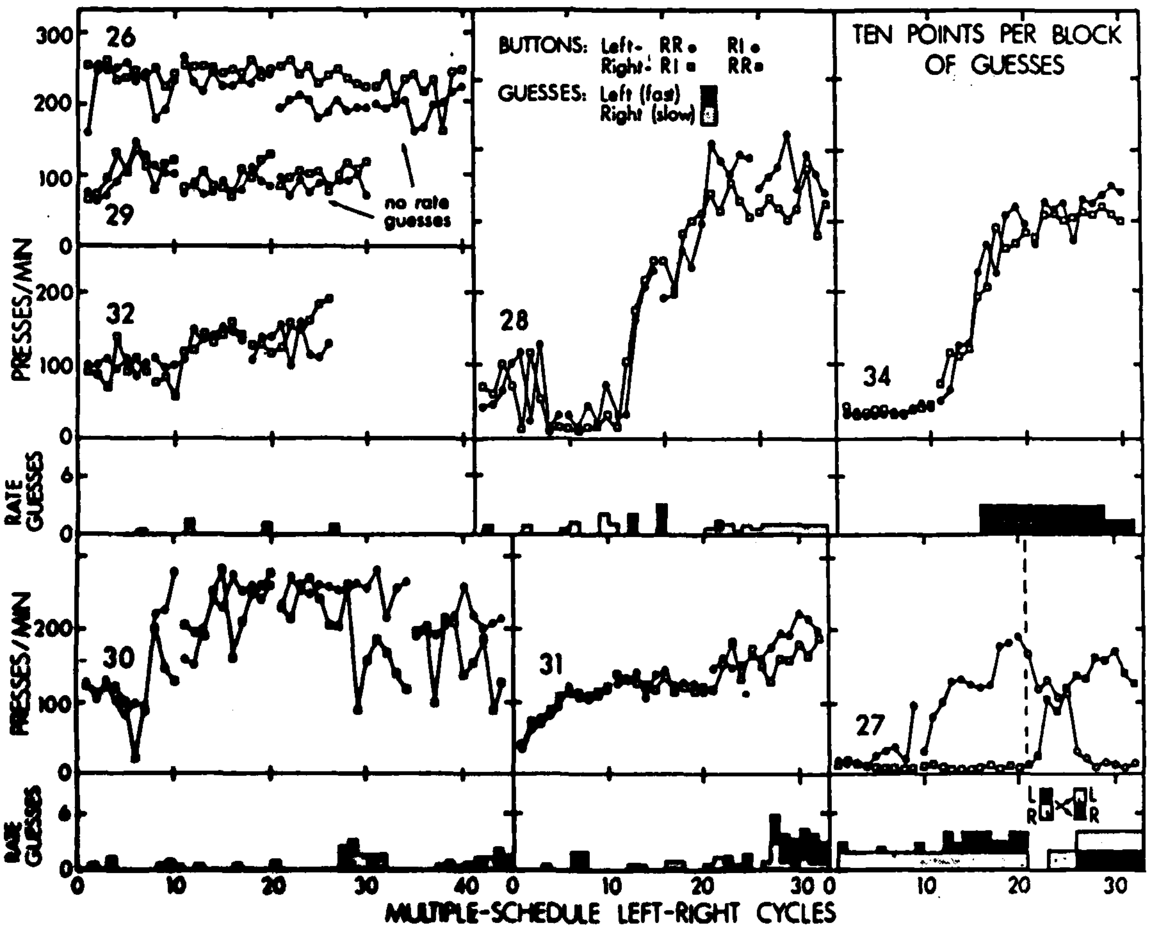

Figure 4. Responding of eight students who received nondifferential points for guesses. Students 26 and 29, combined in a single frame, made no rate guesses. Number of left "fast" guesses and right "slow" guesses in each guess period (maximum of 3 for each button) are shown in the bottom frames for each of the other students. For Student 27, the left-button RR and right-button RI contingencies were reversed at the dashed vertical line, after whi[illegible] "slow" and right "fast" guesses are shown in the bottom frame. Other details as in Figure 1.

Instructed Guesses

Data from the ten students for whom guessing was instructed are shown in Figures 5 and 6. Because guesses were initially instructed, there was relatively little variability in their content and they were therefore classified as "fast," "slow," or "other." In a few cases, students made guesses inconsistent with instructions. Such guesses received no points and typically dropped out quickly.

Figure 5 shows data from students for whom "fast" left and "slow" right guesses initially were instructed. For Student 38, substantial corresponding differences in button-pressing rates accompanied the instructed guesses; when the instructions for guesses were reversed, button-pressing rates continued to conform to guesses, with RR rates decreasing to levels approximating those previously maintained on the RI button. At this point, the instructed guesses controlled pressing rates. In the next session, presses but not guesses were instructed, and each completed guess sheet earned 10 points. Instructions to press controlled both pressing rates and corresponding guesses, regardless of the contingencies for pressing; thus, pressing rate now controlled guessing.

For Student 40, left-button RR rates increased throughout the first session, even when rate guesses were reversed by instructions; this student consistently wrote "press fast" for the right button while pressing slowly. Sensitivity to the different properties of the RR and RI schedules overrode the effects of the guessing instructions. To test sensitivity to these contingencies further, the schedules were reversed, to left RI and right RR schedules; higher rates were maintained by the RR than by the RI schedule, and guesses continued to conform to instructions. In the next session, neither button-pressing nor guessing was instructed; pressing rates remained sensitive to the button-pressing contingencies, but guesses, which no longer had any differential consequences, became consistent with pressing.

For Student 44, instructed guesses affected button-pressing slightly; RR rates were somewhat higher than RI rates. When presses themselves were instructed, the rate difference increased substantially and guesses, no longer instructed, tended to be consistent with the instructed button-pressing. In the final session, neither guessing nor button-pressing was instructed. Although rates were variable, RR rates were always higher than RI rates, and left and right rates reversed when button-pressing contingencies were reversed, three cycles before the end of the session. Guesses were roughly consistent with relative rates of pressing throughout these conditions. In other words, pressing and guessing were both to some degree sensitive to their respective contingencies.

For Student 42, instructed guesses were initially unaccompanied by systematic differences in pressing rates. Instructing pressing itself produced substantial rate differences, and these rates reversed when their instructions were reversed. Guesses, no longer producing differential consequences, became a little variable but conformed substantially to the pressing instructions. When guesses were again instructed, the rate

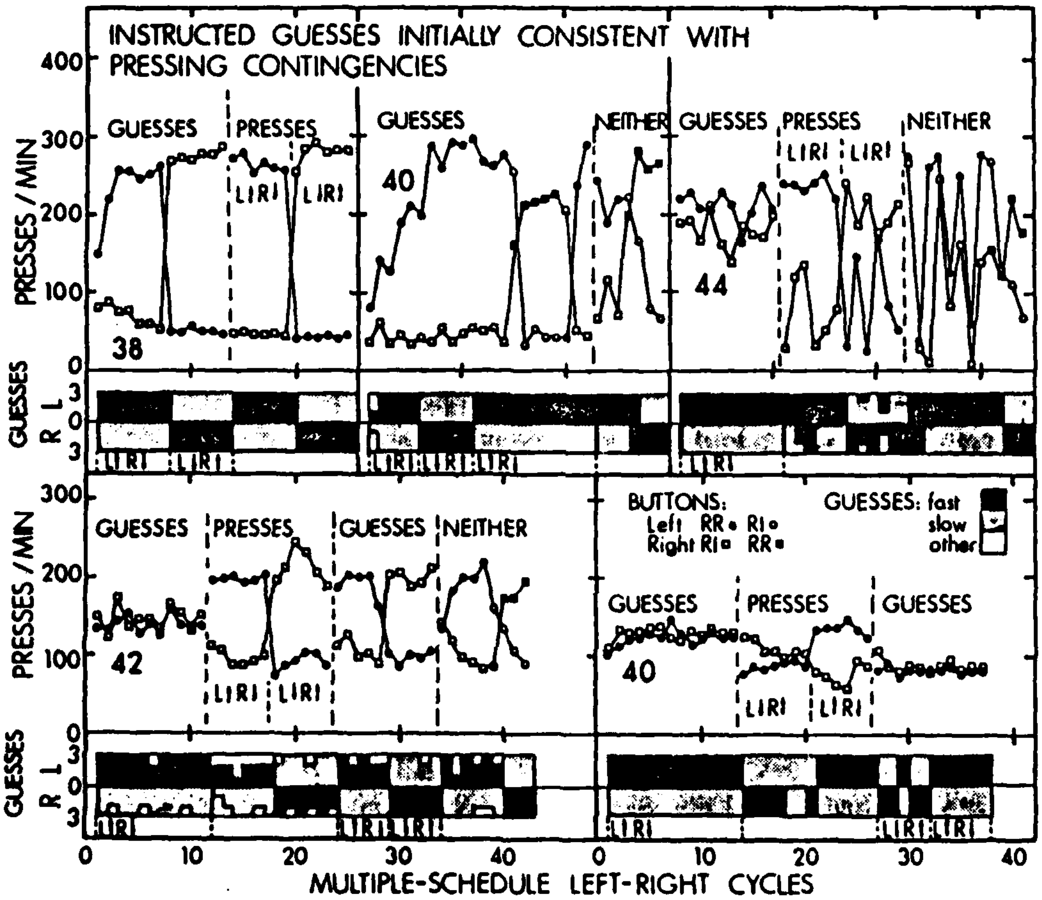

Figure 5. Responding of five students for whom guesses initially were instructed consistent with pressing contingencies (left-button "fast" and right-button "slow"). Top frames show rates of button-pressing. Bottom frames show the three left and three right guesses of each guess period classified into the categories <u>fast</u>, <u>slow</u>, and <u>other</u>. In explorations of the relations between pressing and guesses in individual cases, various sequences of procedures included instructions of "fast" and "slow" guesses (GUESSES), instructions of fast and slow pressing (PRESSES), no instructions (NEITHER), and reversals of the RR and RI button-pressing contingencies, shown by filled (RR) and unfilled (RI) symbols for each button. Arrows labelled L and R in top or bottom frames respectively indicate the direction of instructions for pressing or guesses, according to the same conventions as in Figure 1.

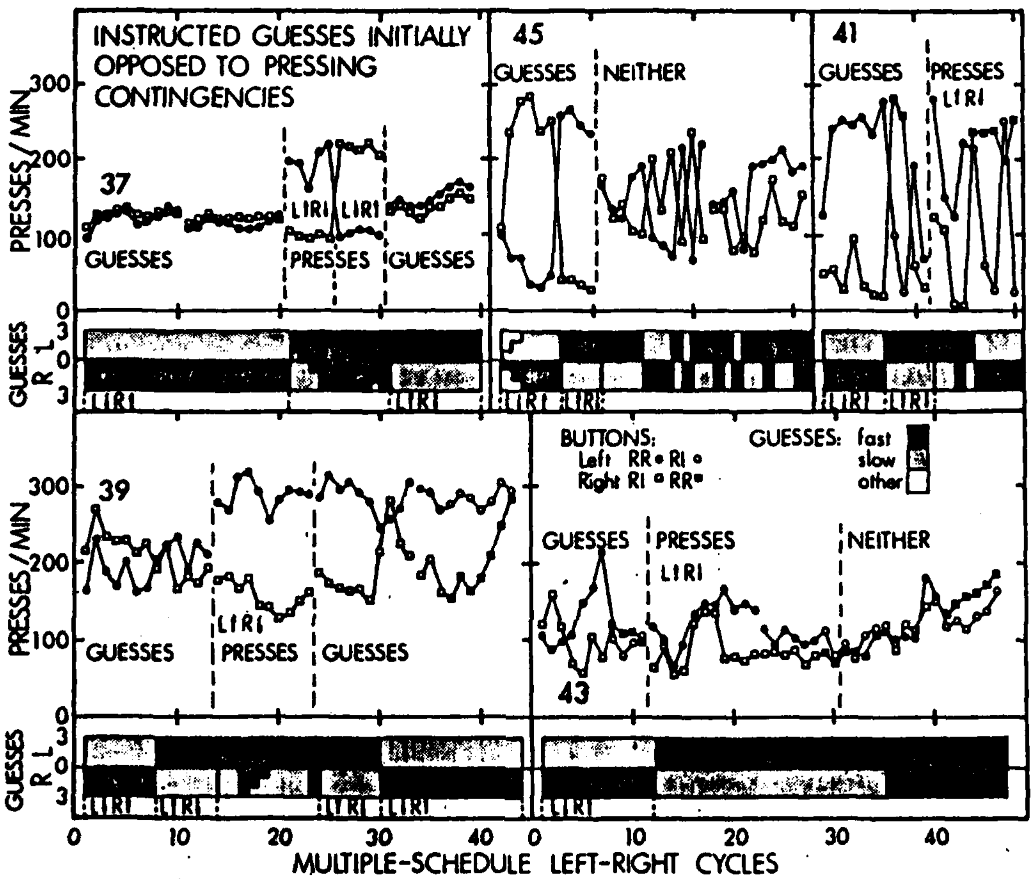

Figure 6. Responding of five students for whom guesses initially were instructed in opposition to pressing contingencies (left-button "slow" and right-button "fast"). Details as in Figure 5.

differences engendered during instructed pressing this time accompanied the instructed guesses. Finally, when neither guesses nor presses were instructed, RR rates were higher than RI rates and reversed, along with corresponding guesses, when the RR and RI contingencies were reversed. Thus, control operated in either direction, nonverbal to verbal or vice versa, depending on the contingencies for each class of responses.

For Student 40, as for 42, pressing rates were initially unaffected by instructed guesses, but separated when pressing itself was instructed. Unlike the results for 42, however, these rate differences were not maintained after the pressing instructions were discontinued and the guessing instructions were reinstated.

Data from five students whose instructed guesses were opposed to the contingencies (i.e., "press slowly" for the left RR button and "press fast" for the right RI button) are presented in Figure 6. For Student 37, instructing guesses had little effect on pressing rates, which were approximately equal for the two buttons. In the next session, presses were instructed, with each guess sheet earning ten points independent of guess content. Differential pressing rates reversed with reversals of pressing instructions, but guesses were "press fast" for both buttons. When guesses were again instructed, this time "fast" for the left RR button and "slow" for the right RI button, RR rates were consistently higher than RI rates but the rate difference was considerably smaller than when presses themselves were instructed.

For Student 45, substantial pressing-rate differences occurred when guesses were instructed. When guess instructions were reversed, both pressing rates and guesses were consistent with the instructions. When neither guesses nor presses were instructed, pressing rates and guesses were variable but pressing rates were generally consistent with guesses in the preceding guess period. By the end of the second session of this condition, RR rates were consistently higher than RI rates, although guessing remained somewhat variable.

For Student 41, left RR rates were higher than right RI rates even though guesses conformed to instructions and were consistent with a rate difference in the opposite direction. When guess instructions were reversed ("fast" left and "slow" right) the difference in pressing rates was unchanged in the next multiple-schedule cycle, demonstrating that pressing was under control of the RR and RI contingencies and was independent of guess instructions. This sensitivity was confirmed when pressing contingencies rather than guess instructions were reversed; pressing rates twice reversed with these contingencies, with RR rates always higher than corresponding RI rates. In the next session, fast left and slow right pressing was instructed; guesses conformed to the higher left-button pressing rates in three of the next four guess periods. Button-pressing contingencies were then reversed again, so that the left button produced points according to the RI schedule even though the rate instructions remained in effect; left rates decreased, right rates increased, and guesses were consistent with button-pressing. Thus, pressing

was sensitive to the pressing contingencies, despite instructions for guesses or pressing; guesses were controlled by guess instructions, but in the absence of instructions they were controlled by pressing contingencies.

For Student 39, button-pressing rates were initially consistent with instructed guesses. Instructing presses themselves, however, produced larger rate differences. When instructions for guesses were reintroduced, the rate differences remained. When guessing instructions were then reversed, pressing conformed to the contingencies (high-rate RR and low-rate RI pressing), even though guesses followed instructions and were consistent with the opposite rate difference. Sensitivity was assessed by reversing contingencies after the third cycle of the fourth session. By the end of that session, right RR rates increased to the level of left RI rates, but additional sessions could not be scheduled.

For Student 43, pressing rates were at first consistent with the instructed guesses, but after four cycles left RR rates gradually increased and right RI rates decreased. Pressing contingencies were then reversed, and left RI rates decreased below right RR rates by the last cycle of that session. In the next session, pressing rates consistent with the contingencies were instructed. Although guesses corresponded to instructed pressing rates, the pressing rates themselves (diverged substantially for only a few cycles, and thereafter) differed only slightly. In the final session, neither presses nor guesses were instructed, and left-button and right-button presses produced points according to RR and RI schedules respectively. Rate differences were inconsistent; when the RR and RI contingencies were reversed, RR rates were consistently higher than RI rates. Thus, in this instance both the relation between guesses and press rates and the effects of RR and RI contingencies were weak.

Generally, guesses conformed to instructions, but the effects on pressing varied. In some instances (e.g., Students 37, 42, 40), the roughly equal pressing rates were similar to those sometimes observed when guesses did not earn differential points. In others (e.g., Students 39, 45, and 38), pressing rates were consistent with instructed guesses. In some cases (e.g., Students 41 and 43), pressing came under the control of the RR and RI contingencies; in others (e.g., Students 42 and 44), control by these contingencies was evident only when neither guesses nor presses were instructed. In summary, consistent control of pressing rates by guesses occurred when guesses were shaped but not when they were instructed. Unlike shaping of guesses, which never did so, instructions sometimes produced pressing rates that were sensitive to RR and RI contingencies.

Discussion

"The one thing psychologists can count on is that their subjects or clients will talk, if only to themselves. And, not infrequently, whether relevant or irrelevant, the things people say to themselves determine the rest of the things they do" (Farber, 1963, p. 196). The assumption that verbal behavior often controls nonverbal behavior, illustrated by this quotation, has

been part of many accounts of human behavior (e.g., Chase, 1938; Jaynes, 1977; Korzybski, 1941; Luria, 1961). Sometimes the assumption is implicit, as when, in educational settings, exposure to textbook descriptions precedes "hands-on" experience, or as when, under the rubric of cognitive-behavior modification (Meichenbaum, 1977), the vocabulary of cognition and cognitive behavior is substituted for the vocabulary of verbal behavior. Sometimes it is explicit. For example, establishing self-instruction and modifying verbal behavior have been important components of self-control procedures (e.g., Bem, 1976; Bornstein & Quevillon, 1976; Burron & Bucher, 1978; Karoly & Dirks, 1977; Monahan & O'Leary, 1971; O'Leary, 1968; Zivin, 1979) and clinical applications (e.g., Brodsky, 1967; Kanfer & Karoly, 1972; Meichenbaum, 1973; Meichenbaum & Cameron, 1974).

The problem for experimental analysis is that verbal behavior is not treated like other sorts of behavior, perhaps because special properties are often attributed to it. The present experiments, which show that the distinction between rule-governed and contingency-governed behavior is relevant to verbal as well as to nonverbal responses (Table 1), are a case in point. The procedures seem obvious and straightforward, and they were technically feasible two or three decades ago. Yet even a laboratory actively concerned with the effects of instructions on human operant responding took several years to hit upon them.

The present findings show that verbal behavior is more likely to determine subsequent nonverbal behavior when it is shaped than when it is instructed. One irony of this behavioral account is its implication that a particularly effective way to change human behavior is to change the individual's private talk or, in other words, to change what the individual thinks. But thinking is behavior, and if such behavior is effective as an instruction, it can still be related to contingencies arranged by the verbal community on the following of instructions and on the correspondence between verbal and nonverbal behavior. Much is to be learned about how the control by such contingencies develops (Risley & Hart, 1968), about the variables that determine the direction of control (verbal to nonverbal or vice versa: cf. Student 9, Figure 1 and Student 27, Figure 4), and about the maintenance of control in the absence of scheduled contingencies (e.g., the confounding, in Figures 5 and 6, of the effects of instructing button-pressing rates and those of terminating differential consequences for guesses). Such questions are important, because the effects of shaped verbal behavior have potent implications for education, clinical settings, and other areas of application.

The cognitive or social psychologist might deal with the differences between shaped and instructed verbal behavior in terms of locus of control or other constructs (e.g., Lefcourt, 1966, 1976). In those terms, students whose guesses were shaped, unaware of the source of control, attributed them to their own behavior and thus responded in accordance with verbal behavior they believed they had generated themselves. Those whose guesses were instructed, on the other hand, recognized the external source of control and responded in various ways, depending on whether they were internal or external types and depending on how they came to formulate the experimental demand charac-

teristics (Orne, 1962). But such an account begins by assuming what the present data show experimentally, i.e., that the students may say things to themselves that affect their subsequent nonverbal behavior. At the worst, the presumably artificial demand characteristics for those students whose guesses were instructed attenuated the control of button-pressing rates by guesses, and the conclusion that verbal behavior can control nonverbal becomes more general rather than less so. Probably more important, control can operate in the other direction as well, and both nondifferential consequences for guesses and instructed guesses (Figures 4, 5 and 6) illustrated the point by providing several examples in which pressing rates controlled guesses instead of the other way around.

In distinguishing between rule-governed and contingency-governed classes of behavior, the present account appeals to an experimentally manipulable dimension of behavior. This distinction, in specifying alternate sources for the control of verbal behavior, becomes part of the descriptive system upon which experimental analyses of behavior are based. In other words, this distinction is now included among our discriminations of the manifold properties of verbal behavior. In dealing with what is special about human behavior, and about human verbal behavior in particular, we can now identify different ways in which verbal behavior is related to nonverbal behavior and to contingencies.

The human participant in an experiment also discriminates, and these discriminations are sometimes judged on the basis of verbal reports. Reservations about verbal reports can be traced back to the very origins of behavior theory, in debates over the nature and reliability of introspections. But the post-experimental verbal report is, if nothing else, behavior. Like other behavior, it is a function of the history that established it, the contingencies that maintain it, and the discriminative stimuli that occasion it (cf. Ericsson & Simon, 1980). In the case of verbal behavior, some of that history resides in the practices of an individual's verbal community, some of those contingencies depend on the reciprocal consequences for speaker and listener that follow from correspondences between verbal and nonverbal behavior, and some of those discriminative stimuli include the nonverbal behavior of which the verbal behavior may be a report. Given that awareness is judged by verbal report, research on awareness (e.g., Brewer, 1975; Dulany, 1968; Farber, 1963; Verplanck, 1962) must take into account the sources of the verbal reports from which such judgments follow. If the distinction between rule-governed and contingency-governed behavior is at all appropriate in this context, then rule-governed awareness must be different from contingency-governed awareness. Some might argue, on the other hand, that there can be no such thing as rule-governed awareness. Those who so argue must say why the contingencies that maintain discriminative control by nonvebal stimuli should have priority over those that maintain the following of instructions.

Private verbal behavior is especially troublesome. It is unrecorded, it is the product of an unknown history, and it is controlled by unspecified contingencies. Yet any account of human behavior that does not take such behavior into account may be flawed. Nevertheless, the students in the

present research were not asked for post-experimental reports. Presumably some but not all would have given evidence of awareness. If what some said they were doing corresponded to what they actually were doing, we might say that those students were aware of contingencies, or at least of their own behavior. But such awareness would simply name a particular sort of verbal behavior; it would not explain anything. The present findings indicate that it is not enough to know about the correspondence between verbal and nonverbal behavior. Even where such correspondences exist, the direction of control, from verbal to nonverbal or vice versa, must be determined experimentally. Once that direction is established, it may further be important, given the present findings, to know whether the controlling response, either verbal or nonverbal, is rule-governed or contingency-governed. The question of awareness may not be relevant to such issues. This does not imply that the problem of knowledge is an illegitimate one. Rather, it suggests that we are only beginning to understand the functional properties of the verbal behavior that must be taken into account in grappling with it.

Finally, these data have direct implications for the development of more effective training programs. Nonverbal performance conformed to contingency-shaped verbal reports regardless of the consequences of the nonverbal performance itself; thus, shaped verbal reports may induce insensitive (unskilled) nonverbal behavior. On the other hand, nonverbal performance was often sensitive to contingencies when the verbal task component was instructed. These data therefore suggest that, if adaptive and contingency-sensitive motor skills are desirable, the verbal behavior might best be instructed; under conditions in which conformity of the verbal and nonverbal performances are preferred, the verbal component should be shaped. The distinction between contingency-shaped and rule-governed behavior is as important for the analysis of verbal as for nonverbal behavior. As the properties of contingency-shaped and rule-governed behavior and the interactions between them become better understood, general principles may be expected to emerge which, in the long run, can be applied to specific training problems to facilitate the development of skilled performance and to improve instructional design.

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